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Bayesian indicator variable selection for multivariate response with application to multi-trait fine mapping

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Nowadays, it is common to jointly analyze multiple correlated responses from the same study. Existing multivariate methods select variables related to all responses without considering the possible heterogeneous sparsity patterns of different responses, i.e. some features may only predict a subset of responses but not the rest. In this paper, we develop a novel Bayesian indicator variable selection method in multivariate regression model with a large number of grouped predictors targeting at multiple correlated responses with possibly heterogeneous sparsity patterns. The method is motivated by the multi-trait fine mapping problem in genetics to identify variants that are causal to multiple related traits. Our new method is featured by its selection at individual level, group level as well as specific to each response. We also propose a new concept of subset posterior inclusion probability for inference to prioritize predictors that target at subset(s) of responses. Extensive simulations with varying heterogeneity and sparsity levels in both low-dimensional and high-dimensional scenarios showed the advantage of our method as compared to existing Bayesian and Frequentist variable selection methods. We then applied our method to multi-trait fine mapping to identify causal variants of multiple related addictive behaviors (nicotine, alcohol and cannabis addiction) and their risk factors and found interesting causal variants responsible for cigarettes per day, alcoholic use and BMI simultaneously that are worth further investigation.